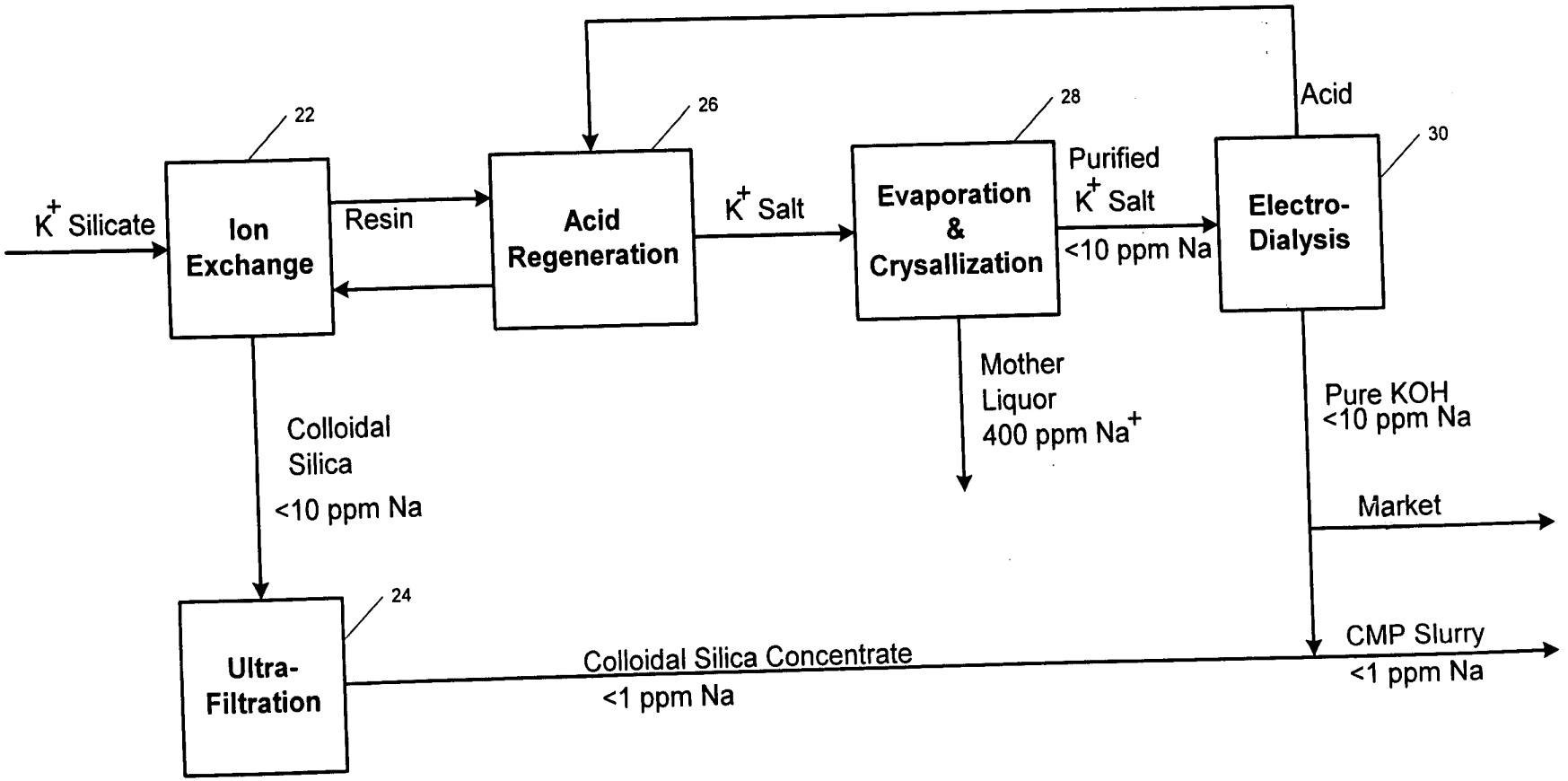
22
26
28
30
Acid
K^+ Silicate
Ion Exchange
Resin
Acid Regeneration
K^+ Salt
Evaporation & Crysallization
Purified K^+ Salt
<10 ppm Na
Electro-Dialysis
Mother Liquor 400 ppm Na^+
Pure KOH <10 ppm Na
Colloidal Silica <10 ppm Na
Market
24
Ultra-Filtration
Colloidal Silica Concentrate
<1 ppm Na
CMP Slurry
<1 ppm Na

FIG. 1

Membrane Configuration for EUR 2-C-5 Stack.

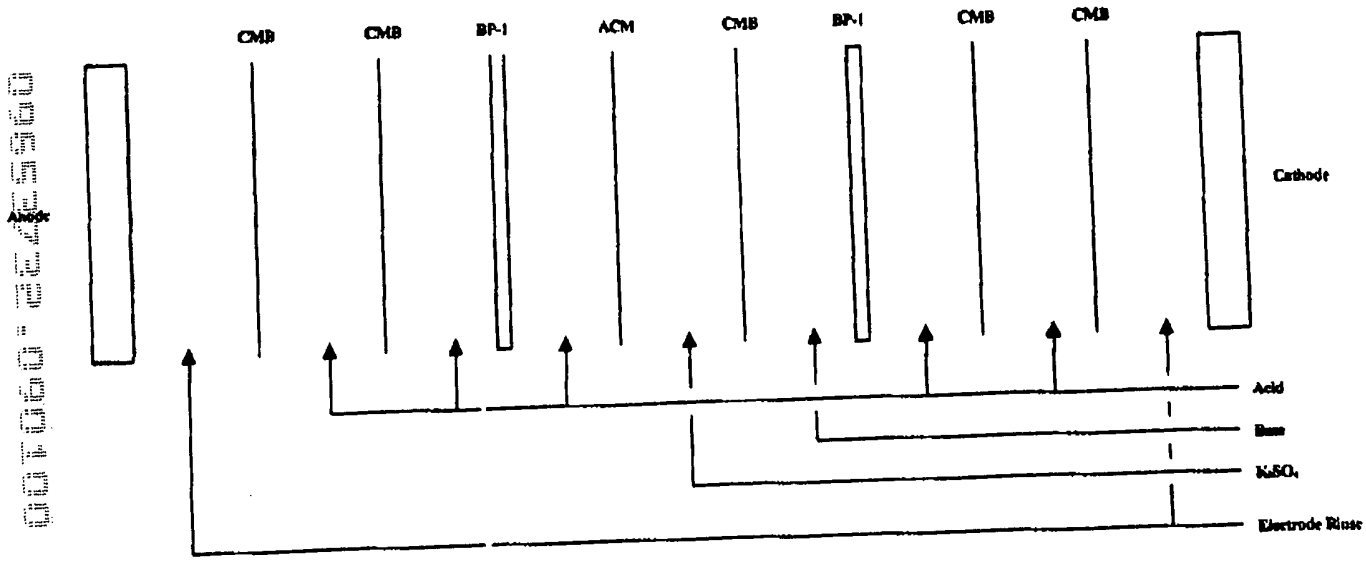

FIG. 2

Membrane Configuration for ED-1 BP Stack.

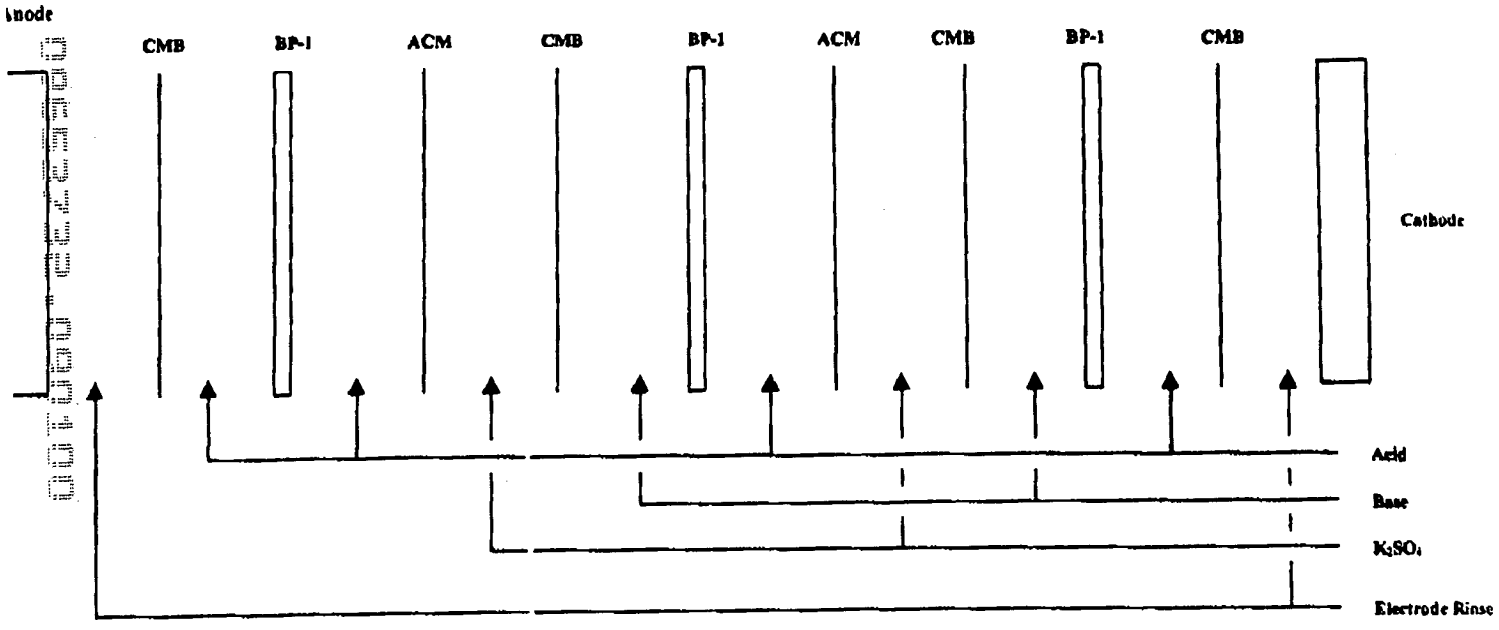

FIG. 3

FIG. 4

Summary of ED Runs (K_2SO_4 splitting)

Run#	Cell/Feed Source	AvgCD / V At Peak CD mA/cm² / V	Init Feed Sulfate Molar	Final Feed Sulfate Molar	Base CE %	Base Cone M KOH / mM SO_4	Water Transport Into Base Mol/mol K^4	Acid CE %	Acid Conc Molar	SO_4 Mass Balance %
484-2	EUR 2-C-5 / Crystal	84 / 14.4	0.53	0.33	84	2.28 / 3.8	2.0	74	1.0	99
484.6	EUR 1-C-5 / Crystal	148 / 162	0.75	0.54	87	2.54 / 1.1	3.3	82	1.1	98
484-22	ED-1 BP / Crystal	187 / 13.5	0.70	0.485	84	2.62/1.1	3.9	76	1.35	103
484-27	ED-1 BP / Crystal	162 / 13.3	0.635	0.375	86	3.55 / 1.6	3.1	65	1.33	99
484/31	ED-1 BP / Hi Na Soln	48/20	0.602	0.527	82	1.23/2.1	3.2	50	0.67	96

FIG. 5

Summary of ED Runs (K_2SO_4 splitting)

Run #	K:Na Mole Ratio in Feed	K:Na Mole Ratio in Base	Partition Coefficient across CMB Membrane K vs Na	Diffusion Coefficient SO_4 m^2/sec	Diffusion Coefficient K into Acid m^2/sec
484-2	-	-	-	$6.0*10^{12}$	$2.1*10^{12}$
484-6	-	-	-	$1..9*10^{12}$	$3.1*10^{12}$
484-22	6405:1	5468:1	0.9	$2.3*10^{12}$	$2.4*10^{12}$
484-27	8596:1	9561:1	1.1	$2.5*10^{12}$	$1.6*10^{12}$
484-31	57:1	45:1	0.8	$2.8*10^{12}$	$1.2*10^{12}$

FIG. 6

Summary of Analytical Results for ED Runs

Run	Initial Feed [Na] / [SO_4] / pH Mg/L / M / pH	Final Feed [Na] / [SO_4] / pH Mg/L / M / pH	Initial Base [Na] / [OH] / [SO_4] Mg/L / M / M	Final Base [Na] / [OH] / [SO_4] Mg/L / M / M	Initial Acid [SO_4] / {K} M / mg/L	Final Acid [SO_4] / {K} M / mg/L
484.6	15 / 0.528 / -	21 / 0.332 / 1.7	1 / 0 / 0	133 / 2.28 / 0.0038	0.5 / 11	1.0 / 127
484-6	9 / 0.750 / 7.5	13 / 0.542 / 2.4	2 / 0 / 0	49 / 2.54 / 0.0011	0.5 / 11	1.1 / 159
484-22	5.5 / 0.698 / 8.5	3.2 / 0.485 / 1.8	0 / 0 / 0	20 / 2.62 / 0.0011	0.582 / 11	1.35 / 1237
484-27	3.6 / 0.635 / 7.5	1.9 / 0.375 / 1.4	0 / 0 / 0	20 / 3.55 / 0.0016	0.472 / 11	1.33 / 1084
484-31	511 / 0.602 / 10.3	403 / 0.527 / 2.0	0 / 0 / 0	349 / 1.23 / 0.0021	0.486 / 11	0.665 / 783

FIG. 7

Summary KOH Electrolysis

Run #	CD/V mA/cm² / V	Charge Passed F	Unit Anolyte [OH} M	Unit Catholyte [OH] M	Final Catholyte [OH] M / %	Cathodic CE %	K:Na mole Ratio in Anolyte	K:Na mole Ratio Transported across Membrane	Partition Coefficient For K vs Na
484.11	200 / 4.6	2.75	2.54	0.1	4.37 / 20.4	98.6	1544:1	6273:1	4.1
484-15	340 / 5.6	2.48	2.52	4.05	7.45 / 32.0	98.7	1617:1	5457:1	3.4

FIG. 8

Summary of Analytical Results for Electrolysis Runs

RUN #	Initial Anolyte [OH[/ [Na] M / mg/L	Final Anolyte [OH] / [Na] M / mg/L	Initial Catholyte [OH] / [Na] M / mg/L	Final Catholyte [OH] / [Na] M / mg/L
484-11	2.54 / 29	1.18 / 25.3	0 / 0	4.37 / 16
484-15	2.52 / 29.4	1.38 / 25.8	4.05 / 19.4	7.45 / 33.6